What is claimed is:

1. A data storage element, comprising:

a substrate comprising a semiconductor material;

a metal oxide layer comprising an electrically insulating rare earth metal oxide disposed upon a surface of said substrate;

a conductive material disposed upon said metal oxide layer;

a first electrode electrically connected to said conductive material; and a second electrode connected to said substrate.

- 2. The data storage element as set forth in Claim 1, wherein said metal oxide comprises lanthanum oxide.
- 3. The data storage element as set forth in Claim 1, wherein said metal oxide comprises a mixture of lanthanum oxide and aluminum oxide.
- 4. The data storage element as set forth in Claim 3, wherein said conductive material comprises metallic aluminum.
- 5. The data storage element as set forth in Claim 1, wherein said metal oxide comprises at least one of:
 - 1) lanthanum oxide, and

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- 2) a mixture of lanthanum oxide and aluminum oxide, and said conductive material comprising metallic aluminum.
- 6. The data storage element as set forth in Claim 1, wherein said metal oxide layer has a thickness of 10-10,000 Angstroms.
- 7. The data storage element as set forth in Claim 6, wherein said metal oxide layer has a thickness of 50-500 Angstroms.
 - 8. The data storage element according to claim 1, wherein said conductive material comprises polysilicon.
 - 9. The data storage element according to claim 1, wherein said conductive material comprises Aluminum.
 - 10. A data storage element, comprising:a substrate comprising a semiconductor material having a source regionand a drain region formed in a surface of said substrate;
 - a layer of metal oxide disposed upon said surface of said substrate and between said source region and said drain region, said metal oxide comprising at least one metal which has a plurality of exidation states;
 - a conductive layer disposed upon said layer of metal oxide;



a first electrode electrically connected to said conductive layer; a second electrode connected to said source region; and a third electrode connected to said drain region.

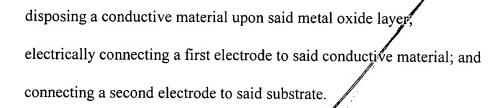
- 11. A data storage element as set forth in Claim 10, said semiconductor material being n-doped silicon, said metal oxide comprising at least one of lanthanum oxide and a mixture of lanthanum oxide and aluminum oxide, and said conductive layer comprising metallic aluminum.
- 12. The data storage element as set forth in Claim 10, wherein said semiconductor material comprises n-doped silicon.
- 13. The data storage element as set forth in Claim 10, wherein said metal oxide comprises at least one of lanthanum oxide, and a mixture of lanthanum oxide and aluminum oxide.
- 14. The data storage element as set forth in Claim 10, wherein said conductive layer comprises metallic aluminum.
- 15. A method of forming a data storage element, said method comprising:

 forming a metal oxide layer on a substrate, said metal oxide layer

 comprising an electrically insulating rare earth metal oxide disposed upon a

 surface of said substrate;

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- 5 16. The method of claim 15, wherein said metal oxide comprises lanthanum oxide.
 - 17. The method of claim 15, wherein said metal oxide comprises a mixture of lanthanum oxide and aluminum oxide.
 - 18. The method of claim 17, wherein said conductive material comprises metallic aluminum.
 - 19. The method of claim 15, wherein said metal oxide comprises at least one of:
 - 1) / lanthanum oxide, and
 - a mixture of lanthanum oxide and aluminum oxide, and said conductive material comprising metallic aluminum.
 - 20. The method of claim 15, wherein said metal oxide layer has a thickness of 10-10,000 Angstroms.



- 21. The method of claim 20, wherein said metal oxide layer has a thickness of 50-500 Angstroms.
- 22. The method of claim 15, wherein said conductive material comprises polysilicon.
- 23. The method of claim 15, wherein said conductive material comprises Aluminum.
- A memory, comprising:

a rare-earth based memory element using hysteresis and current-voltage characteristics thereof to store data.

- 25. The memory as set forth in Claim 24, wherein said memory element comprises:
 - a substrate;
- a metal oxide layer comprising an electrically insulating rare earth metal oxide disposed upon a surface of said substrate; and
 - a conductive material disposed upon said metal oxide layer.
- 26. The memory as set forth in Claim 25, wherein said metal oxide comprises lanthanum oxide.

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- 27. The memory as set forth in Claim 25, wherein said metal oxide comprises a mixture of lanthanum oxide and aluminum oxide.
- 28. The memory as set forth in Claim 27, wherein said conductive material comprises metallic aluminum.
- 5 29. The memory as set forth in Claim 25, wherein said metal oxide comprises at least one of:
 - 1) lanthanum oxide, and
 - a mixture of lanthanum oxide and aluminum oxide, and said conductive material comprising metallic aluminum.
 - 30. The memory as set forth in Claim 25, wherein said substrate comprises n-doped silicon, said metal oxide comprising at least one of lanthanum oxide and a mixture of lanthanum oxide and aluminum oxide, and said conductive material comprising metallic aluminum.

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